

CONVERGENT BIOLOGICAL PROCESSES IN COALESCING RHODOPHYTA

Bernabé Santelices, Juan A. Correa, Diego Aedo, Verónica Flores, Marcela Hormazábal, and Pablo Sánchez

Abstract

Sporeling coalescence in *Gracilaria chilensis* Bird, McLachlan et Oliveira produces genetically polymorphic, chimeric individuals. If this is common in red algae, it may have significant biological consequences. In this study, we evaluate the hypotheses that coalescence is widespread among the Rhodophyta and that specific and convergent morphological and ecological responses characterize this as a unique growth style among marine algae. A literature survey on coalescence was undertaken to assess the distribution of this condition in the Florideophycidae. Sixty-two (54.9%) of 113 species considered germinated to form a disk. Subsequent development in 37 of these species showed crust formation and coalescence during development with other crusts in 31 species (84%). Coalescing red algae were members of the orders Ahnfeltiales, Corallinales, Gigartinales, Gracilariales, Halymeniales, Palmariales, and Rhodymeniales. Ultrastructural studies in species of *Ahnfeltiopsis*, *Chondrus*, *Gracilaria*, *Mazzaella*, and *Sarcothalia* suggested a common pattern of early development. Newly released, naked spores may fuse into a single cell, as they do in *Chondrus canaliculatus*, or they may develop individual cell walls that later are surrounded by a thickened common wall. Ultrastructural studies demonstrated two kinds of immediate development after the first mitotic division: direct development by symmetric divisions resulting in discoid sporelings or an indirect asymmetric arrangement of divisions before a discoid sporeling was formed. Germination in coalescing species is a linear function of the initial spore density, whereas in noncoalescing species maximum germination occurs at intermediate densities. In the field, coalescing species may recruit either from solitary or aggregated spores. However, survival is significantly higher for plantlets grown from a larger number of coalescing spores. Total number of erect axes formed by the coalesced mass is a logarithmic function of the initial number of spores. Thus, germlings grown from a larger number of coalescing spores exhibited a larger photosynthetic canopy than do plantlets grown from a few spores. Juveniles and mature clumps grown from a coalescing mass may exhibit size inequalities among erect axes, with the larger axes located toward the center of the clump. These larger axes mature first or, in some cases, are the only to produce spores. The widespread occurrence of coalescence in roughly half the number of orders of the Florideo-phycidae, the similarity of the coalescence process, and the finding of various adaptive traits associated with coalescence characterizes this as a unique growth style, splitting the diversity of species now included in the Florideophycidae into two major groups: coalescing and noncoalescing Rhodophyta.

Key index words: *Ahnfeltiopsis*; chimeric individuals; *Chondrus*; coalescing Rhodophyta; *Gracilaria*; *Mazzaella*; *Sarcothalia*; sporeling coalescence